US-IT-HXTU
Pressure drop distribution

The goal of this note is to determine the contribution of the JT heat exchanger pressure drop, out of measurements registred during the US-IT-HXTU campaign test (juillet 2000). Every pressure values are extracted from the data point serial, selected when the controlled valve (PCV9305) was 100% opened. The selected data are choosen for various massflows.

Figure 1 shows the measurement of the total pressure drop (HXTU + cryo. facilities) and the estimated pressure drop distribution for the cryogenic valve box and the cryoline to the CCU. The pressure drop of the focussed JT heat exchanger is deduced from this distribution.

Figure 2 shows calculation of the JT heat exchanger pressure drop scaled down from previous measurements performed on a similar device.

Figure 3 shows different pressure drops due to the sudden expansion through a ID39.2mm.

Note for figure 1 :

- DP_{total} is measured by means of two absolute pressure gauges PT500B (located in the cryoline, before CCU) and PT9314 (in the accumulator of the HXTU).
  (remarque: no relative, therefore exact pressure drop measurement).

- DP_{valve} is the pressure drop calculated out of an assembly drawing issued by CERN.
  Hypothesis for the calculation of the pressure drop for choosen data points:
  - T =3 K, Variable pressures (16-24mbar); used for helium properties given by « Hepak ».
  - The inner diameter, ID, of the connection pipe to the ∅150mm cryoline is equal to 39.2mm, (OD=42.4mm, DN32).

- $DP_{cryoline}$ is estimated using the ratio, mdot^3, and extrapoled from the given DP of 2 mbar at 12g/s. The exact measurement performed at CERN was: 1mbar at 12g/s for 45m of line.

- $DP_{JTHX} = DP_{total} - DP_{valve} - DP_{cryoline}$

Remarques:

The contribution of the cryogenic valve box is reduced to the pressure drop due to the sudden expansion of the cold helium from the ID39.2 mm to the ∅150 mm cryo. line.

The pressure drop through the DN50 controlled valve itself (part of the valve box), is of the order of 0.75mbar for 16g/s at 21mbar, therefore it is not taken into account in the current estimation. The pressure drop due to elbows is, as well, negligeable.

Instrumentations used, see the US-IT-HXTU Process and Instrumentation Diagram:

TT9337, PT9314 are the temperature and the pressure on the HXTU and valve box side.
PT500B and FT697 are the pressure before the CCU and the warm mass flow after the CCU.

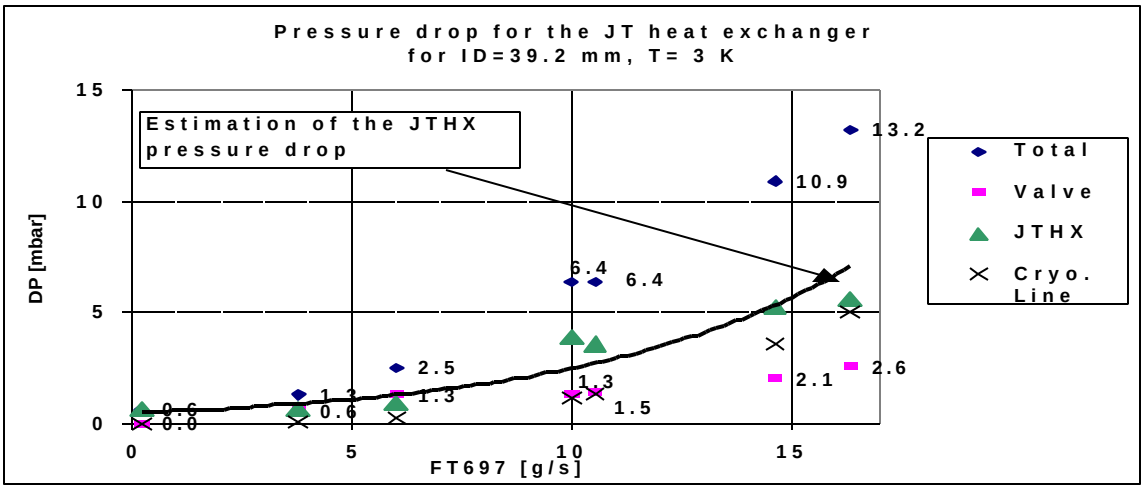

Fig1 : Distribution of the pressure drop, based on the US-IT-HXTU campaign test measurement.

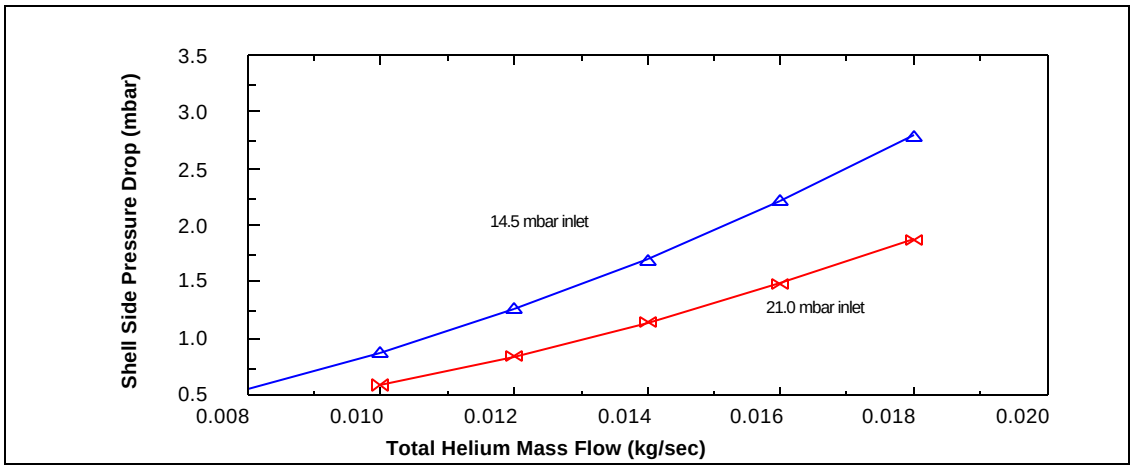

Fig.2 : JT Heat Exchanger Pressure Drop Analysis (July 21, 2000 Tom Peterson)

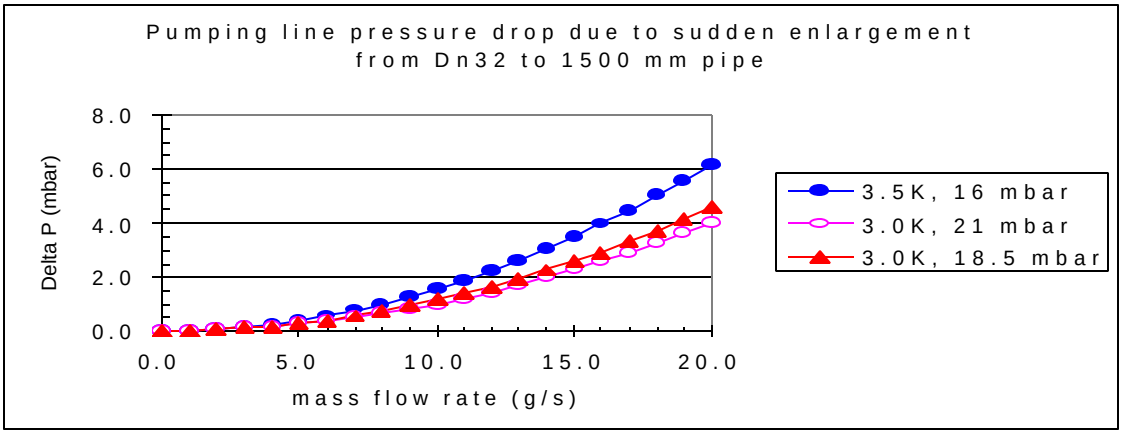

Fig.3 : Calculations of the pressure drop for a sudden expansion (Yuenian Huang)